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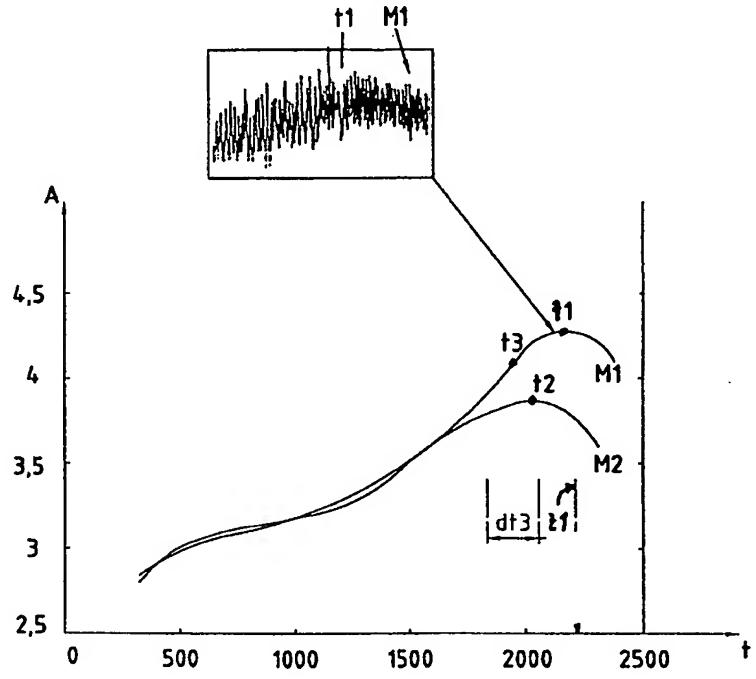
(54) Title: A METHOD OF PRODUCING A MIXTURE AND A BAKING PLANT

(57) Abstract

The present invention relates to a method of mixing flour, water and other recipe-related ingredients in a dough mixer (41) to produce a pre-selected end product in a baking plant (40) while evaluating (106) the rheological properties of the dough mixture. A dough-forming process or sequence is terminated at a time-point (t3) before reaching a virtual time-point (t1) at which such a dough-forming process would produce a dough that exhibited maximum rheological properties. The process terminating time-point (t3) is chosen on the basis of predetermined factors. Said factors comprising at least the properties (48) of the flour used and/or the requirements placed on the end product.



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TITLE OF INVENTION: A METHOD OF PRODUCING A MIXTURE, AND A BAKING PLANT

FIELD OF INVENTION

The present invention relates primarily to a method of mixing flour, water and other ingredients, included in a recipe, for a pre-selected or predicted end product, such as an oven-baked product that contains flour.

Although the concept of the invention encompasses all flour-containing and baked products, the invention will be described hereinafter essentially with respect to the baking of bread loaves, by way of example.

It will be understood that the mixture, dough or pastry mixture, obtained by mixing together flour, water and other ingredients, does not necessarily contain one single type of flour, but may contain several different sorts of flour.

The inventive method utilises a dough mixer whose construction can, in principle, include any known type of dough mixer.

The invention also enables the rheological properties of the dough mixture to be evaluated either continuously or discontinuously during operation of a chosen mixer, including its visco-elastic properties, such as its stretch strength, toughness, tenacity and/or glutinousness of the dough and its elasticity.

The present invention also relates to a baking plant adapted for use with the inventive dough-mixing method and including a selected dough mixer, among other things.

The dough mixer will, in this case, be provided with means, or connected to means, which enable time-wise variations in the rheological properties of the dough mixture to be evaluated.

The baking plant will also conveniently be able to use a baking process control unit of known construction.

BACKGROUND OF THE INVENTION

There are known in the art several different methods of mixing together flour, water and possibly other recipe ingredients to form a mixture, a dough or pastry mixture, in a dough mixer so as to produce a pre-selected or predicted end product, and a baking process that includes said dough mixer.

In a first category of baking processes, said processer are carried out in so-called "domestic or local bakeries", in which a larger or smaller part of the baking process is performed manually by one or more bakers.

In a second category, the baking processes are performed in more automated baking plants that are equipped with control units that function to monitor all stages of the baking process and to control different process stages.

The invention can be applied in both of these categories, although the invention will be exemplified in the following with reference to the second category, for the sake of simplicity.

It is known that the quality and nature of the flour or flour-mixture used or the characteristics exhibited by the flour or flour-mixture during the dough-making mixing process are of decisive significance in the case of baking

processes that are directed towards a certain end product that shall have characteristics or singularities associated with predetermined requirements. For instance, it will be necessary to adapt the baking process to the quality of the flour concerned and also to other special characteristics in general.

It is known to establish the parameters of flour and other flour-related properties with the aid of a standard test method, the so-called-Farinograph method-.

This method, the results of which are shown in Figures 1 and 2 in respect of two different sorts of flour, requires a flour sample to be mixed with a given quantity of water in a standard dough mixer with standard power consumption and time-wise variation during the mixing sequence, to provide a graph.

The appearance and statistical properties of each such graph will thus provide relevant information relating to the properties of the flour-mixture tested.

The graph compiled, in accordance with this method, has a significant region, a so called humped region, whose "peak" values are able to provide data and values relating to the maximum current consumption and therewith the point in the dough-forming process at which the dough has reached "maximum" rheological properties, i.e. is most viscous

The appearance of the graph, i.e. the distribution of the current values in time during the dough-forming process, also enables other parameters to be evaluated, such as prevailing stability-time, consistency and water content.

When controlling a baking process towards an end product that shall have pre-selected or predetermined properties, it is

known to evaluate the obtained end product by establishing its volume, porosity and/or perishability, among other things.

In both categories of baking processes, in which flour and water are mixed in a standard dough mixer while considering the result obtained with the Farinograf method, it is necessary, in principle, to follow a chosen recipe with respect to the dough mixer used in the baking process, the flour, the water and the mixture of ingredients, so that the resultant mixture will exhibit maximum rheological properties that can be expected to occur with maximum current consumption.

However, it has been found difficult to stop the dough-forming process at a significant "peak" value, and in practice this process has been stopped within a region covered by the humped region, resulting in a great deal of uncertainty, expecially when the humped region has a wider spread than a more pointed humped region.

Bakers that bake home-made bread normally stop the dough-making or mixing sequence manually while relying on their experience and knowledge of the desired consistency of the flour mixture.

Thus, it is known to terminate the dough-forming sequence in the dough mixer at said maximum current consumption value and to pass the dough through the baking plant, where the dough is removed from the mixer, shaped and laid-up and divided into appropriate parts and, when necessary, kneaded and shaped, stored during a resting time, allowed to rise, baked, allowed to cool, and the final product optionally packaged.

SUMMARY OF THE PRESENT INVENTION

TECHNICAL PROBLEMS

When taking into consideration the technical deliberations that a person skilled in this particular art must make in order to provide a solution to one or more technical problems that he/she encounters, it will be seen that it is necessary initially to realise the measures and/or the sequence of measures that must be undertaken to this end on the one hand, and to realise which means is/are required in solving one or more of said problems on the other hand. On this basis, it will be evident that the technical problems listed below are highly relevant to the development of the present invention.

When studying the present standpoint of techniques, as described above, it will be seen that, with regard to baking processes, a technical problem resides in providing conditions whereby the quality of the final end product, according to pre-selected requirements, can be improved with regard to optimum properties in combination with a lower dough-mixer energy input.

Another technical problem is one of realising the significance of and the advantages afforded by stopping the dough-mixing process in the dough mixer at a selected time-point, appearing prior to that point in time at which the flour/water/ingredients mixture related to the recipe would exhibit maximum rheological properties.

When considering the above, another technical problem will be seen to reside in realising the measures that must be taken in baking processes in order to obtain maximum, or at least essentially maximum, properties with respect to a number, preferably all, final product requirements, in relation to the flour quality used among other things.

It will also be seen that a technical problem is one of realising the significance of being able to evaluate the rheological properties of the dough mixture while observing the test result obtained with the type of flour used in the Farinograph method.

Another technical problem is one of realising the significance of and the advantages afforded by terminating the dough-forming sequence in the dough mixer at a calculated time-point, that is related to the quality of the final product and that occurs prior to the actual time-point at which such a dough-forming process would exhibit maximum rheological properties.

It will also be seen that a technical problem also resides in realising which factors shall be observed when selecting the time-point at which the dough-forming sequence shall be terminated in order to provide chosen optimal properties of the final product, and also the mutual significance of these factors.

It will also be seen that a technical problem is one of realising the significance of and the advantages afforded by primarily observing the properties of the flour/water mixture according to the Farinograph method as a factor for the evaluation of said time-point.

Another technical problem is one of realising the significance of being able to chose said time-point in relation to qualities required of the final product, and also of observing factors such as those that relate to the design of the baking plant.

Another technical problem is one of realising the significance of calculating and selecting said time-point

while taking into account one or more factors that relate to ingredients and/or baking plant.

It will also be seen that a technical problem is one of enabling a critical time-point at which the dough-forming sequence is stopped in the dough mixer, with the aid of simple measures, so as to obtain a final product that has desired properties, by observing the total composition of the mixture, the properties of the flour, according to the Farinograph method, and the time-wise change in flour characteristics.

Another technical problem is one of realising the significance of choosing said time-point while taking into account one or more quality properties, such as porosity, durability, volume, freshness, etc., of the final product.

Still another technical problem is one of realising the significance of choosing said time-point while taking into account the subsequent baking process and particularly the kneading process or kneading sequence carried out in the baking plant.

SOLUTION

With the intention of solving one or more of the aforesaid technical problems, the present invention takes as its starting point a method and a baking plant in which flour, water and other recipe-related ingredients are mixed together in a dough mixer adapted for the manufacture of a pre-selected end product while evaluating the rheological properties of the dough mixture, such as its visco-elasticity such as glutinousness, stretch strength, viscosity, plasticity and/or elasticity.

According to the invention, the dough-forming process carried out in the dough mixer shall be terminated at a time-point which lies prior to a virtual time-point at which the dough formed by said mixing process or sequence would have exhibited maximum rheological properties, had said daugh-forming processing been allowed to continue, and that the time-point at which said process or sequences is terminated is chosen on the basis of predetermined factors, these factors comprising at least the properties of the flour used and/or the requirements placed on the end product.

According to further developments of the invention, the aforesaid time-point is chosen while taking into account one or more of the following ingredient-related factors: the total composition of the mixture, the properties of the flour according to the Farinograph method-, and the time-wise change in the flour.

According to another embodiment, the aforesaid time-point may be chosen while taking into account one or more of the following quality properties of the end product: the porosity of the end product and its durability, volume, freshness, etc.

According to still another embodiment of the invention, the aforesaid time-point may be chosen while taking into account one or more of the following factors relating to the baking plant: laying the complete or divided dough or mixture formed in the mixer onto a laying-off plate, resting said dough during a time sequence, kneading of the dough, dough fermentation or rising time and dough fermentation conditions, baking time and baking conditions, product cooling time and product cooling conditions, and possible packaging of the end product.

ADVANTAGES

Those advantages that are primarily afforded by an inventive baking method and baking plant reside in the creation of conditions for controlling the structure of the end product towards maximum properties, primarily by mixing flour, water and other recipe-related ingredients in the dough mixer such as to obtain rheological properties that are slightly below and precede the maximum rheological properties of the dough or mixing process and/or properties.

This does not only result in a shorter baking process but also reduces the energy consumption of the dough mixer in comparison with known processes.

The primary characteristic features of an inventive method of mixing flour, water and other ingredients to form a dough for the manufacture of a pre-chosen or pre-selected or predicted product are set forth in the characterising clause of the following Claim 1. The characteristic features of a baking platn, using a dough mixture produced in accordance with the method, are set forth in the characterising clause of the following Claim 5.

BRIEF DESCRIPTION OF THE DRAWINGS

An inventive method and an adapted baking plant having features characteristic of the present invention will now be described in more detail with reference to the accompanying drawings, in which;

Fig. 1 is an example of a graph that shows the quality of a first flour sort in a flour/water mixture produced in accordance with the -Farinograph method-;

Fig. 2 is an example of a graph that shows the quality of a second flour sort in a flour/water mixture produced in accordance with the -Farinograph method-;

Fig. 3 illustrates graphs that show time-related power consumption of a dough mixer used in a baking process in which two different recipes requiring two mutually different flour qualities are followed; and

Fig. 4 is a block schematic illustrating a baking plant that includes a control unit and also the units significant of the present invention.

DESCRIPTION OF EMBODIMENTS AT PRESENT PREFERRED

Since the inventive method has already been described above, reference will be made primarily to the description that has already been given although the method will be explained still further by references to the following description.

Figures 1 and 2 are graphs related to two different flour-qualities and their flourwater mixtures, the individual properties of which are determined in accordance with the -Farinograph method-.

The Farinograph method is a standard method for testing types and grades of flour, in which a specific quantity (weight) of flour is mixed in a standard dough mixer while adding a given quantity of water.

The time-wise variations of electric current values to the motor driving the dough mixer during the dough-forming

process or sequence are plotted on a graph. Thus, the graph shown in Figure 1 is plotted in accordance with the -Farinograph method- with regard to one type of wheat flour, sold in Sweden under the designation or Trade Mark "Bagarens bästa", that has a dough development time of 7.0 and a consistency change of 85.

Figure 2 is a graph on which the time-wise variation of the current valueshas been plotted in respect of another type or sort of flour.

This shows a dough development time of 3.0 and a consistency change of 85.

Other factors and characteristic features of a flourwater mixture can be evaluated from a graph obtained in accordance with this method.

For instance, the magnitude of the so-called peak value P, which occurs at mutually different time-points in the two Figures (after 7 minutes in Figure 1 and after 3 minutes in Figure 2) can be considered to constitute a measurement of the time at which the dough-forming process or mixing sequence will exhibit maximum rheological properties, i.e. is most viscous and has high plasticity and/or elasticity values.

The peak value P occurs as a highest mean current value formed during a significant hump-like region of the graph.

The stability time S is also a significant factor when assessing flour quality.

Consistency, defined as the time distance applicable to a centre line L, is also significant when determining the properties of the flour/water mixture.

It shall also be possible to evaluate the water content of the mixture.

Evaluation of the flour qualities concerned according to Figures 1 and 2 is earlier known and does not therefore lie within the concept of the present invention, although it is highly significant when applying the invention in practice.

Figure 3 includes two graphs relating to an average change calculation in the power consumption of a dough mixer in time for two different sorts of flour mixed with water and other ingredients required by the actual recipe.

The curves, shown in Figure 3, show, in principle, that the initial increase in current consumption with time essentially is the same for the different flour qualities and that decisive differences occur only in the terminating part of the curves, or graphs.

It will be seen that the highest current value occurs at time-point t1 in respect of one flour quality M1 and a special recipe herefor.

This maximum current value occurs at time-point t2 in respect of a flour quality M2 and a special recipe for this quality.

The time-points t1 and t2 will be considered to be equal in the following description, and consequently the following description is made solely with reference to the flour quality and recipe M1 with the maximum current value at time-point t1. The same principle deliberations are, however, made with respect to both flour sorts M1 and M2 in accordance with the invention.

The wheat flour sort included in the recipe M1 is assumed to be the flour sort designated "Bagarens bästa", whereas the flour sort included in the recipe M2 is assumed to be a pastry wheat-flour.

Figure 3 shows, with an enlarged curve-part section adjacent to and including the time-point t1 that the single-line current curve shown is represented by calculated mean-value curves.

Since the current consumption is maximum at time-point t1, the rheological and/or glutinous properties of the dough mixture, such as stretch strength or the like, are also at a maximum, and if the dough mixer continues to mix after said time-point t1, the dough structure will be broken down and therewith result in a much poorer end product.

It is thus a normal procedure with all known techniques to attempt to stop the dough-forming process or sequence at the time-point t1.

The present invention is based on a mixing of the ingredients of a given recipe in the dough mixer, and terminating the dough-forming process at a time-point t3, that occurs before the virtual time-point t1 at which such a mixture would exhibit maximum rheological properties, if the mixing process was allowed to continue, i.e. have maximum visco-elastic properties, such as stretch strength.

According to the invention, the time-point t3, at which the dough-forming process is terminated, is chosen on the basis of predetermined factors.

One decisive factor relates to the properties of the flour used, according to the -Farinograph method-, shown in Figures 1 and 2.

The factors that shall be observed and that require early termination of the dough-forming process can be divided into ingredient-related factors, factors relating to the end product, and factors relating to the baking process and to the baking process equipment.

Examples of such factors are:

Factors related to the used Ingredients.

1a. The total composition of the mixture.
1b. The properties of the flour and of the flour mixture respectively according to one or more data obtained from the -Farinograph method-.
1c. The time-wise change in the flour and other ingredients.
1d. The rheological and/or visco-elastic properties of the flour and other ingredients.

Factors related to the end product:

2a. The nature of the end product (bread loaf, buns, cakes).
2b. The porosity of the end product.
2c. The volumetric measurement of the end product (length, breadth, height).
2d. Durability or freshness of the end product.

Factors relating to the baking equipment:

3a. The construction of the dough mixer.
3b. The mixing capability of the dough mixer, speed selection.
3c. Fast and leaven-dough equipment.
3d. Weighing machine construction.
3e. Construction of the dough laying-off part or section of the plant.

3f. The duration of the dough resting time/or dough fermentation time.

3g. Length of storage time, temperature and storage space construction.

3h. Oven construction, choice of temperature, choice of temperature changes, oven time.

3i. Construction of the cooling zone, choice of temperature, choice of temperature changes, cooling zone time.

3j. Packaging system.

It has been found that subsequent processing of the dough into separate parts or clumps at time-point t3 is well able to provide a dough-forming sequence that stands in relationship with the dough-forming sequence that would otherwise take place in the dough mixer if mixing was allowed to continue to time-point t1.

Practical experiences show that when selecting only one factor, with the intention of maximising the result of the end product through the influence of this factor, among those given above, the time-point t3 herefor will fall within a time region "dt3" shown in Figure 3.
When another factor is chosen, a maximum-related value will also fall within the time section "dt3".

It has surprisingly been found that maximum-related efforts undertaken with a plurality of the aforesaid functions towards a maximum-adapted end product normally require the dough-mixing process to be terminated at a time-point located within the time section -dt3-, and that each choice of a specific critical time-point t3 for terminating the dough-mixing process will result in purely maximum values with respect to certain properties of the end product and in almost maximum values in respect of other properties.

Figure 4 is a schematic illustration of one embodiment of a baking equipment 40, where the individual process sequences are illustrated in block form.

Shown to the left of Figure 4 are three separate containers 40a, 40b and 40c, each adapted to accommodate the ingredients of a chosen recipe, adapted for a desired and pre-selected end product.

For the sake of simplicity, it is assumed that the container 40a contains flour of one sort, that the container 40b contains water, and that the container 40c contains one or more ingredients included in a pre-chosen end product recipe, e.g. to produce a loaf of bread.

A mixture of the ingredients needed to provide the end product is delivered to a dough mixer 41. The mixer is driven by a motor (not shown) which is powered by electricity delivered on cables 41a via an electric current evaluating unit 41b.
This latter unit 41b is also connected by a cable 106 to monitoring or control equipment or unit 100.

The current evaluating unit 41b is adapted to enable the rheological properties of the dough mixture to be evaluated (106), such as viscosity, plasticity and/or elasticity.

When the dough is mixed in the mixer 41 to a time-point t3 with the rheological properties slightly beneath the maximum rheological properties manifested at the following time-point t1, the dough is processed further in a dough dividing and kneading unit 42 and the individual kneaded and loaf-shaped lumps of dough are passed to a storage or dough-fermentation unit 43 and from there into an oven 44, from where the products are passed to a cooling unit 45. The individual

loaves of bread are now passed to a packaging apparatus, as indicated at 46.

The monitoring and controlling unit 100 used in the baking process receives information and/or data relating to the settings of the baking plant via cables 101-104.

Information is transmitted, through a smart card via an information carrying medium, or a magnetic carrier 48, to a unit 49 with information relating to the structure of the flour concerned according to the -Farinograph method-, wherein the unit 100 is constructed to send to the unit 41b at an evaluated time-point t3, via the cable 105, a signal for stopping the dough-forming process in the dough mixer 41.

The information carrier 48 may conveniently contain all parameters for the properties obtained via the -Farinograph method- and/or other factors. It is particularly proposed in accordance with the invention that all properties are evaluated from a graph according to Figures 1 or 2 obtained with the measuring system used, and controlled by the properties of a sampled input signal.

It will be understood that the description of the signal exchange sequence and monitoring of the system through the medium of the control unit 100 merely constitutes an example.

It will, of course, be understood that other known methods can be used in this regard.

A remote control system is proposed in this respect, either with or without physical connections.

It will also be understood that the invention is not restricted to the described and illustrated exemplifying embodiment thereof, and that modifications and variations can

be made within the scope of the inventive concept as defined in the following Claims.

CLAIMS

1. A method of mixing flour, water and other recipe-related ingredients, to produce a pre-selected and/or predicted end product, in a dough mixer while evaluating the rheological properties of the dough mixing or mixture, **characterised** by terminating a dough-forming process at a time-point that lies prior to a virtual time-point at which such a process would produce a dough that exhibited maximum rheological properties if it were allowed to continue; and selecting said process terminating time-point on the basis of predetermined factors, said factors at least comprising the properties of the flour used and/or requirements placed on the end product.

2. A method according to Claim 1, **characterised** by choosing said terminating time-point while taking one or more of the following ingredients-related factors into account: the total composition of the mixture, the properties of the flour according to the -Farinograph method-, the time-wise change in the flour.

3. A method according to Claim 1 or 2, **characterised** by choosing said terminating time-point while taking into account one or more factors relating to the end product, such as end product related porosity, durability, volume and/or freshness.

4. A method according to Claim 1, **characterised** by choosing said terminating time-point while taking into account one or more of the factors related to a used baking plant, such as the process of laying-out the dough, resting time for the dough, kneading the dough, dough fermentation time and/or dough fermenting conditions, baking time and/or baking conditions, cooling time and/or cooling conditions, and/or packaging of the end product.

5. Baking plant which includes a dough mixer for mixing together flour, water and other recipe-related ingredients to produce a pre-selected or predicted end product, means for evaluating the rheological properties of the dough mixture, and means for monitoring and/or controlling a baking process, **characterised** in that the monitoring and/or control unit is adapted to terminate a dough-forming sequence or process at a time-point that lies before a virtual time-point at which said sequence or process would produce a dough that exhibited maximum rheological properties; and in that said process terminating time-point is chosen on the basis of predetermined factors, wherein said factors comprise at least the properties of the flour used and/or the requirements placed on the end product.

6. Baking plant according to Claim 5, **characterised** in that said terminating time-point is calculated in the control unit while taking into account one or more ingredient-related input factors, such as the total composition of the mixture, the properties of the flour according to the -Farinograph method-, the time-wise change in the flour.

7. Baking plant according to Claim 5 or 6, **characterised** in that said terminating time-point is calculated in the control unit while taking into account one or more input factors related to the end product, such as the porosity of the end product, its durability, volume, freshness.

8. Baking plant according to Claim 5, **characterised** in that said terminating time-point is calculated in the control unit while taking into account one or more input factors related to the baking plant, such as the dough laying-out process, its resting time, the dough kneading process, the dough fermentation time and dough fermenting conditions, the baking time and baking conditions, the cooling time and cooling conditions, and/or packaging of the end product.

9. Baking plant according to Claim 5, **characterised** in that the occurring dough properties are related to a graph produced by a measuring system and the properties of an input signal.

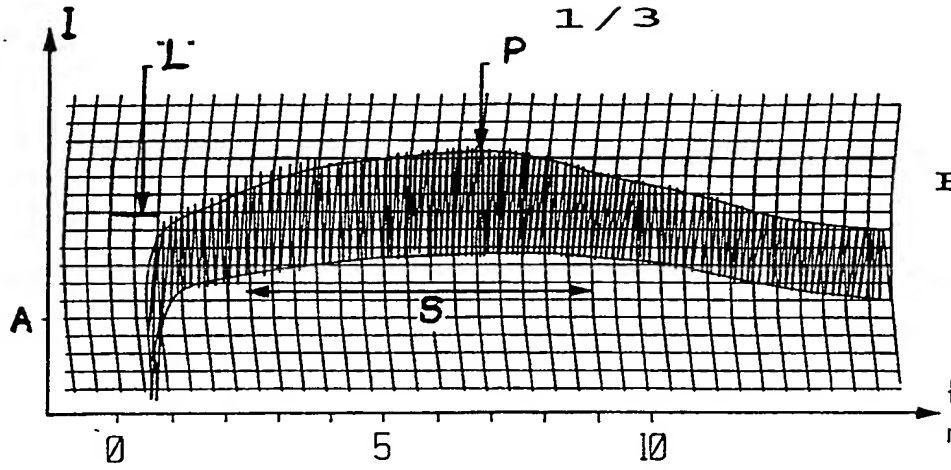

Fig. 1.

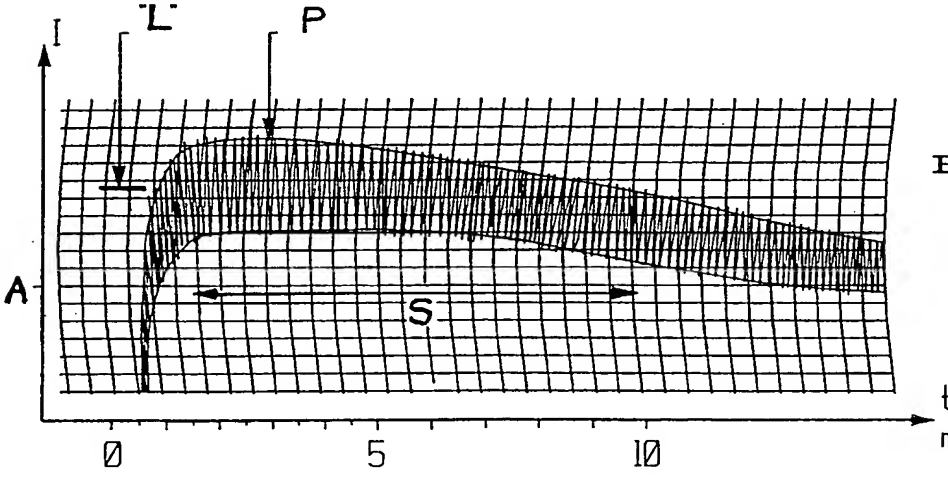

Fig. 2.

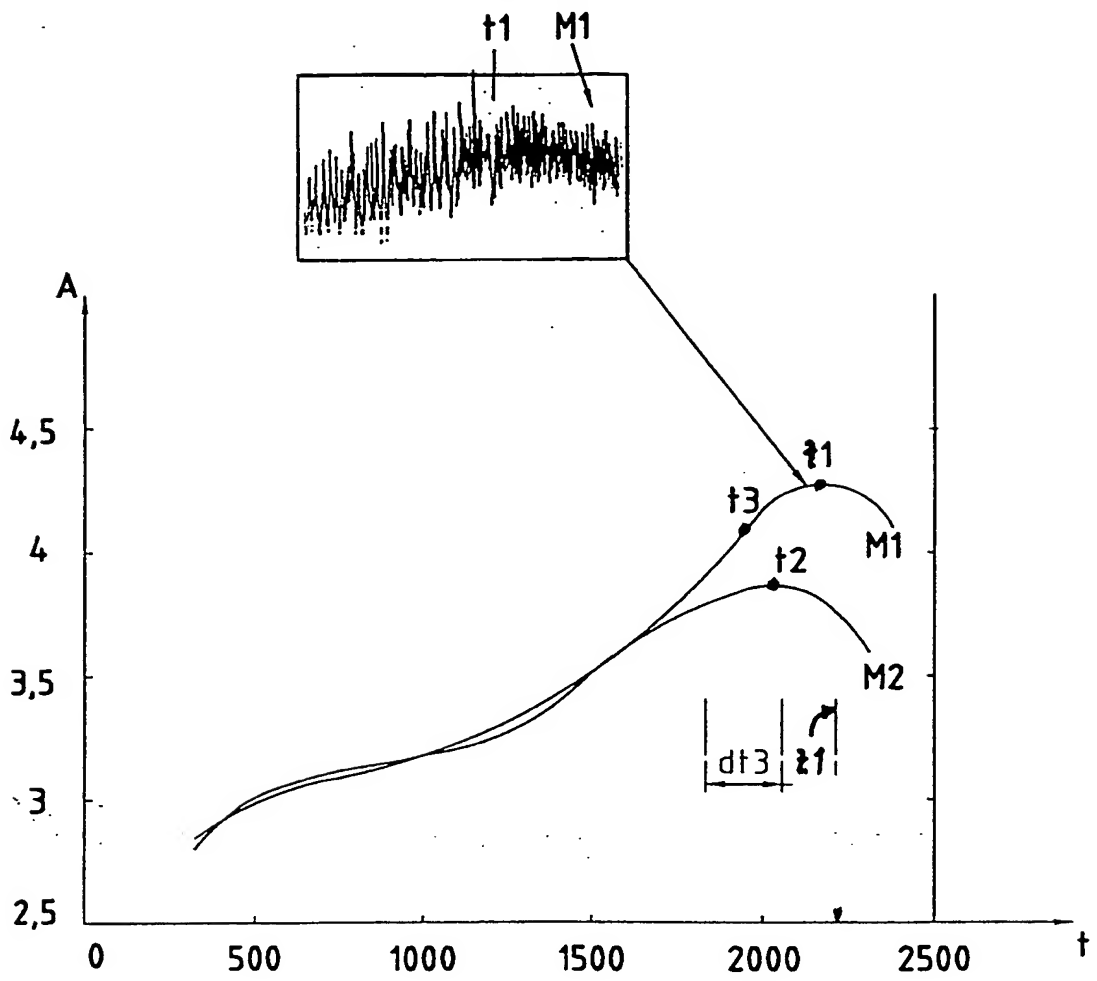

Fig. 3.

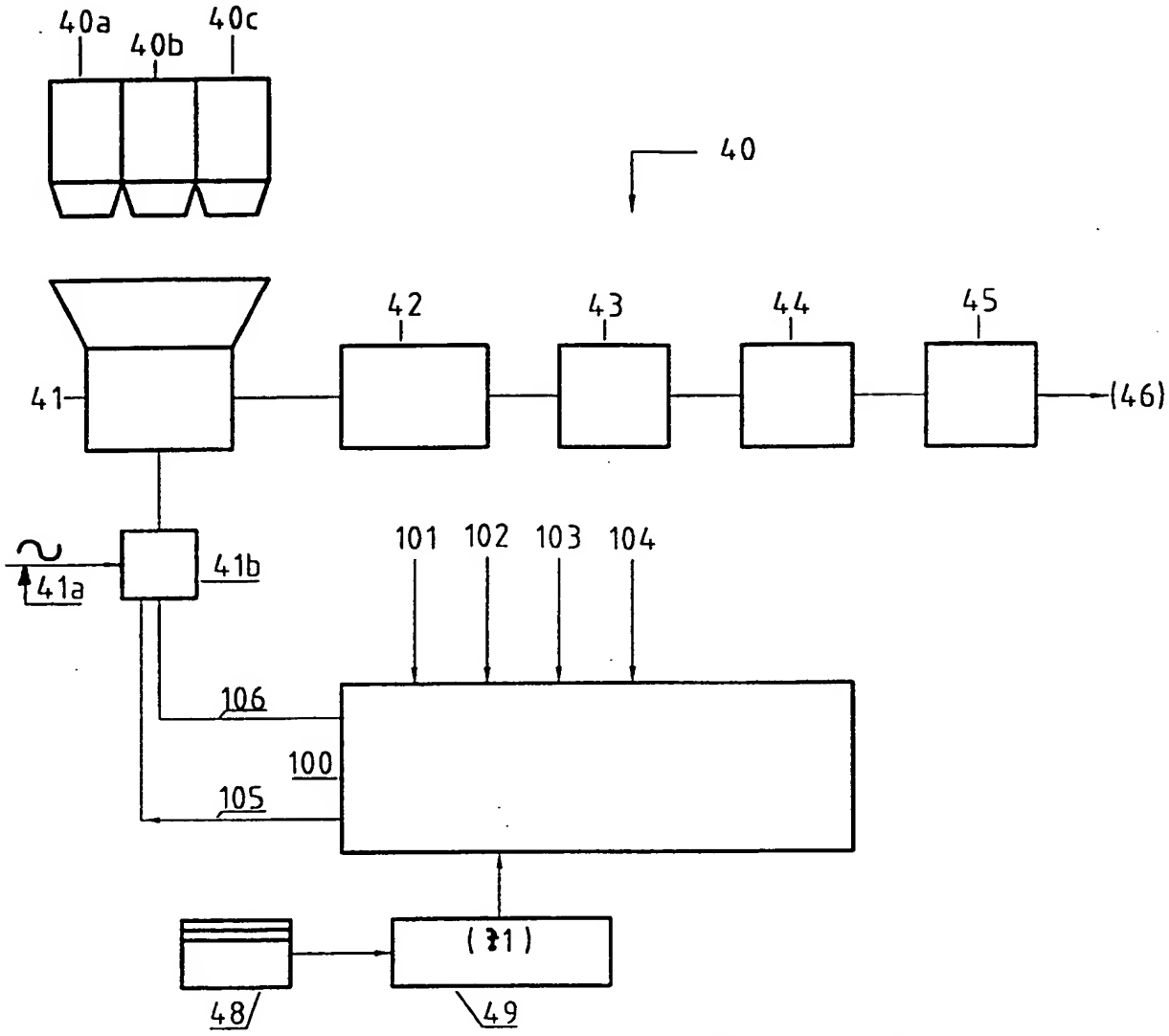
40a
40b
40c
40
41
42
43
44
45
(46)
41a
41b
101
102
103
104
106
100
105
(31)
48
49

Fig. 4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01889

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A21D 8/02, A21C 1/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A21D, A21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0428241 A1 (SYSTEM SOUGOU KAIHATSU CO., LTD.), 22 May 1991 (22.05.91), see especially page 1, lines 23-26 and page 2, lines 30-34 --	1-9
X	US 5472273 A (EDDIE R. FOWLER ET AL), 5 December 1995 (05.12.95) --	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 January 1999	16 -02- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hampus Rystedt Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/12/98

International application No.
PCT/SE 98/01889

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0428241 A1	22/05/91	DE 69020863 D,T	04/04/96
		JP 1881949 C	10/11/94
		JP 3155741 A	03/07/91
		JP 6000036 B	05/01/94
US 5472273 A	05/12/95	NONE	